

# DOCTOR OF PHILOSOPHY

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## EVOLVING A SIMULATION MODEL PRODUCT LINE SOFTWARE ARCHITECTURE FROM HETEROGENEOUS MODEL REPRESENTATIONS

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National- and Department-level decision-makers expect credible Department of Defense models and simulations (M&S) to provide them confidence in the simulation results, especially for mission-critical and high-risk decisions supporting national security. Many of these large-scale, software-intensive simulation systems were autonomously developed over time, and subject to varying degrees of funding, maintenance, and life-cycle management practices, resulting in heterogeneous model representations and data. Systemic problems with distributed interoperability of these non-trivial simulations in federations' persist, and current techniques, procedures, and tools have not achieved the desired results. The Software Architecture-Based Product Line for simulation model representations, employing Architecture Readiness Levels presented in this dissertation provides an alternative methodology. The proposed four-layered M&S software architecture-based product line model enables the development of model representations supported by readiness levels. Each layer reflects a division of the software architecture-based product line. The layer represents a horizontal slice through the architecture for organizing viewpoints or views at the same level of abstraction, while the software architecture-based product line represents a vertical slice. A layer may maintain multiple views and viewpoints of a software architecture-based product line. A Domain Metadata Repository prescribes the interaction between layers. The Domain Integrated Product Development Team concept is introduced.

**KEYWORDS:** Model and Simulation, Software Architecture, Product Lines, Architecture Description Languages, ADL, Extensible Markup Language, XML, Verification, Validation, Readiness Levels, Interoperability, Heterogeneous Model Representations, Heterogeneous Data, Credibility, Confidence, Distributed Development